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Prediction Of New Students Using The Exponential Smoothing Method (Case Study: STMIK Kaputama)

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Abstract

With this prediction system for the number of new students, it functions to determine the priority of how many new students will be accepted in the following year. For each new teaching according to the factual and quite accurate new student data reports by implementing a computerized system, the data processing will be more precise and reduce errors in predicting it. This prediction will provide an overview based on the trend of the number of new students at STMIK KAPUTAMA. The method used is the exponential smoothing method by looking for how big the error is with different alpha values, namely 0.1 to 0.9. Each alpha tested will give different results. The purpose of the above calculation is to find out (a) alpha which produces the smallest forecast error. By taking data on the number of new students in the previous period, forecasting by determining the value of weight (a) alpha. The value of weight (a) alpha depends on the number of new students, where the nature of this forecasting determination of the value that is closest to the actual conditions. The forecasting results above are the closest to the overall number of new students alpha 0.9 is 1,207.9 and forecast error is 15.75.

Keywords: *Exponential Smoothing, Prediction of Number of New Students*

1. Introduction

Higher education is an institution of advanced secondary education aimed at making students members of society who in their application and development have academic and professional skills [1] The number of new students accepted in some universities will affect the learning and teaching process, so knowing the number of new students is one of the things that can be used for planning materials in the teaching and learning process, because it will be related to the number of existing lecturer comparisons. Therefore, it should be necessary to predict the number of new students to prepare everything. Prediction is an action to estimate future circumstances based on past data. Forecasting in the modern era as it is now widely used. Because by using existing forecasting and predictions, it will help to know the number of new students to come. In STMIK KAPUTAMA, the number of new students is a very important thing, especially private campuses. Many decisions can be made depending on the number of students owned including the comparison of the number of new students STMIK KAPUTAMA Binjai one of the private campuses in the city of Binjai that the number of students is not stable every year. On the campus of STMIK KAPUTAMA has not been able to determine the number of new students each year whether it increases or not in the coming year therefore to support the performance of STMIK KAPUTAMA Binjai in decision making one of the factors is the number of new students [2].

In the prediction system sometimes have problems, problems arise because often have difficulty in determining the number of new students, based on the needs of STMIK KAPUTAMA Binjai to predict the number of prospective new students, it is very important to utilize the calculation of the exponential smoothing method by finding how big the error. For STMIK KAPUTAMA Binjai, this prediction serves to determine the priority of how many new students will be accepted in the next year, as well as for each new academic year in accordance with the actual campus new student data report so that it can save time in the process of predicting and the results are quite accurate and can be accounted for. By implementing a computerized system, the data processing process will be more precise and reduce errors in predicting it. Based on the above background, the author is interested in conducting research in the form of a thesis entitled “prediction of the number of new students using exponential SMOOTHING method”.

2. Research Method

2.1. Understanding Prediction

The meaning of prediction is the same as a forecast or forecast. According to the Indonesian dictionary, prediction is the result of predicting or predicting or estimating values in the future using past data. Predictions show what will happen in a given situation and are inputs to the planning and decision-making process.

Predictions can be based on scientific methods or purely subjective. Take for example, weather predictions are always based on the latest data and information based on observations including by satellites. Likewise, predictions of earthquakes, volcanic eruptions or disasters in general. However, predictions such as football matches, sports, etc. are generally based on a subjective view with one's own point of view predicting it.

Although the in-depth study of future alternatives is a new discipline, perhaps people have been paying great attention to what will happen later since humans began to know things. The population of fortune-tellers going back to ancient and medieval times was a manifestation of people's desire to know about their future. This concern about the future continued and even developed into an astrological column syndicated in 1973.Here are some predictions according to experts:

a. Predictions do not have to give definite answers to events that will occur, but rather try to find answers as close as possible to what will happen [3].
b. Forecasting is an objective calculation and by using past data to determine something in the future [4].
c. Forecasting is a process to estimate some of the needs in the future which includes the needs in terms of quantity, quality, time and location needed in order to meet the demand for goods or services [5].
d. Prediction is a process of systematically estimating about something that is most likely to happen in the future based on past and present information that is owned, so that the error (the difference between something that happens and the estimated results) can be minimized [6].

Forecasting is a procedure for creating factual information about future social situations on the basis of existing information on policy issues. Divination has three main forms:

a. Projections, predictions and forecasts. A projection is a forecast based on extrapolation of past and present tendencies into the future. Projection makes a firm question based on arguments obtained from certain methods and parallel cases.
b. A prediction is a forecast based on firm theoretical assumptions. These assumptions can take the form of theoretical laws (e.g., the law of diminishing the value of money), theoretical propositions (e.g., the proposition that the breakup of civil society is caused by a gap between expectations and capabilities), or analogies (e.g., the analogy between the growth of government organizations and the growth of biological organisms).
c. A conjecture is a forecast based on an informed or expert assessment of the future situation of society.

The purpose of the holding of policy forecasting is to obtain information about changes in the future that will affect the implementation of the policy and its consequences. Therefore, before the recommendations are formulated, there is a need for Policy Forecasting so that truly accurate recommendations will be obtained to be applied in the future. In predicting future needs based on the past, it takes someone who has high sensitivity and is able to read the possibilities of the future. Policy Forecasting is also needed to control, in the sense of trying to plan and establish policies so that they can provide the best alternatives to action that can be chosen among the various possibilities offered by the future. The future is also sometimes heavily influenced by the past. With reference to the future the policy analyst should be able to assess the value of what can or should guide future action.

2.2. Classification and prediction

According to Han (2007) classification and prediction are two forms of data analysis that can be used to extract models describing important classes of data or to predict future data trends. Such analysis can help to provide a better understanding of big data. If the classification predicts labels that are categorical (discrete and unordered), the prediction models a continuous value function.

2.3. Exponential Smoothing

Exponential Smoothing is another technique that can be used to smooth out time series, a way that can get a picture of a long-term overall movement in the data. exponential smoothing is used to obtain a long-term forecast (one or two periods to come) on a time series. It is called exponential smoothing because this method can provide a series of moving averages that are weighted exponentially throughout the time series, that is, throughout the series, each smoothing calculation or forecasting in the future depends on all the values of the preceding observations.

Exponential smoothing method is a development of the method of moving averages. In this method of forecasting is done by repeating the calculation continuously using the latest data. Each data is given a weight, the newer data is given a greater weight. Two methods in exponential smoothing include single exponential smoothing [7].
Forecasting conducted by researchers is a quantitative type of forecasting. Quantitative forecasting can be used when there are 3 conditions, namely:

a. There is information about the past.
b. This information can be quantified in the form of data.
c. It can be assumed that some aspects of past patterns will continue in the future.

"The quantitative forecasting approach uses a variety of mathematical models, which can be trusted for historical data and variables associated with forecasting demand. With a quantitative approach, one can include the projection of historical data as well as the development of associative methods" [8].

2.4. Advantages and disadvantages of exponential Smoothing

The list of advantages of exponential Smoothing is:

1. Easy to learn and apply.

Only three data sheets are required for the exponential smoothing method. First, a forecast for the most recent time period is required. Two, it needs to be the actual value for the time period. And thirdly, a value alignment constant is needed, a weighting factor that reflects the weight given to the latest data values.

2. Generate accurate forecasts.
   The exponential smoothing method generates a forecast for one period forward. Using the trend projection technique, forecasts for subsequent periods can be generated. The forecast is considered accurate because it takes into account the difference between the actual projection and what actually happened.
3. This gives more meaning to recent observations.
   The observed Data is the sum of two or more components, one of which is a random error that is the difference between the observed value and the actual value. In the smoothing technique, random variations ignored. Therefore, it is much easier to see the phenomena of which it is composed.

The list of shortcomings of exponential Smoothing is:

1. Generates forecasts that lag behind the actual trend.
   Lag is a side effect of the smoothing process. There's a reason this method has the name "smoothing" because it ignores the ups and downs associated with random variation. Thus, looking at this graph shows a smoother line or curve. But ignore random variation also allows you to see the phenomena it composes, which helps when presenting data and making forecasts of future values.
2. Can't handle trends well.
   Exponential smoothing is best used for short-term forecasting and in the absence of seasonal or cyclical variations. As a result, forecasts become inaccurate if there is data with cyclical or seasonal variations. Therefore, this kind of average will not work well if there is a trend in the series.

2.5. Single Exponential Smoothing

Exponential smoothing is a moving average forecasting technique with weighting where the data is weighted by an exponential function. Exponential smoothing is a moving average forecasting method with advanced weighting, but it is still easy to use. This method does very little mutilation of past data [9]. The " single exponential method Smoothing is the development of a simple moving avarage method, which initially uses the formula:

$$F_{t+1} = \frac{X1 + X2 + ... + XT}{T} \quad \text{.....(2.1)}$$

Description :
Ft+1: forecast for the period to t + 1
XT: the real value of the period to t
T : moving average timeframe

2.6. Moving Average

Variable is an attribute or nature or value of people, objects or activities that have certain variations that are set by researchers to be studied and then drawn conclusions [9] To clarify, the symbol X is given as a free variable and the symbol Y as a bound variable.

a. Independent variable
   Variables that cause or affect the bound variable. On this calculation is played by the period of the academic year.
b. Bound Variable
   Variables that are caused or affected by free variables. On the calculation played by the number of new students.

3. Results And Discussion

3.1. Research Methodology

Research methodology is a scientific process or way of obtaining data that will be used for research purposes. Methodology is also the theoretical analysis of a means or method. In conducting the study, the authors follow the stages of methodology in this study are as follows [10], [11]:

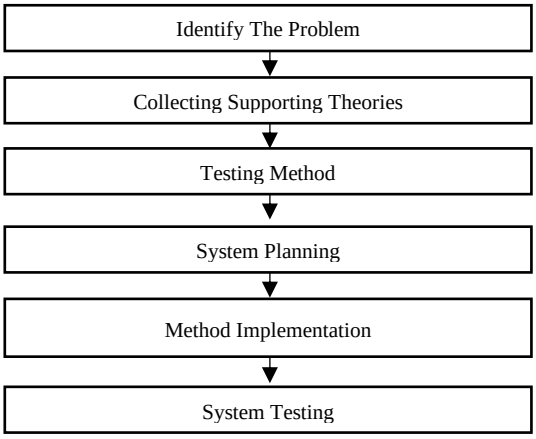

Fig. 1: Research Methodology

To clarify the structure of the research methodology above, the authors make the following statement [12], [13]:

1. Identify The Problem
   This stage is the initial stage used to identify problems with the aim to observe and find problems being faced on the object of research is the number of new students STMIK KAPUTAMA Binjai.
2. Collecting Supporting Theories
   Collection of theories related to the subject matter such as The Theory of exponential Smoothing and other theories needed. In this stage, the theory is collected from several sources such as books, journals, articles and other references.
3. Testing Method
   At this stage the researcher will test the methods used in the process of determining the right prediction, with existing guidance on supporting theories from books and journals related to the subject matter.
4. System Planning
   At this stage, the design of the system to the problem under study, can be a stage to design the workflow of the system and also design the design of the face-to-face view of the system to be made.
5. Method Implementation
   Implement methods that have been tested previously with the design of the system that has been made and make the appropriate coding with the programming language used to create the system.
6. System Testing
   At the final stage, a series of tests are carried out on the system that has been made, tests are carried out in order to find errors in the system and make the necessary improvements so that the system built can be used properly.

3.2. System Analysis

Forecasting is the process of predicting unknown circumstances in the future. STMIK KAPUTAMA Binjai is a private campus business entity in which there is a process of predicting the number of new students. The number of students each year is often not appropriate estimates then used with exponential smoothing method to obtain data by direct observation to obtain the necessary data. The research Data that will be used in this study is taken from the data of students of the 2018 – 2022 batch.

3.3. Research Design

The number of students on campus is something that is very important, especially private campuses. Many decisions can be made depending on the number of students owned including the comparison of the number of lecturers and students, buildings for teaching and learning and other facilities on campus. STMIK Kaputama Binjai is one of the private campuses in Binjai where the number of students increases every year.

The data collection was taken based on the data of students who registered for the last 5 years starting from the 2018 academic year to the 2022 academic year at STMIK Kaputama Binjai. These data can be seen in the following tables :

Table 1: The number of new students in Stmik Kaputama Binjai

	RE-REGISTER				
Year	**SI – S1**	**TI – S1**	**MI – D3**	**KA – D3**	**Amount**
2018	71	119	36	15	241
2019	158	104	14	10	286
2020	186	102	19	10	317
2021	170	94	24	14	302
2022	168	109	28	-	305

The method used as the basis of forecasting is the exponential Smoothing method. Forecasting process using exponential Smoothing method is needed in order to solve the problem of predicting the number of new students STMIK KAPUTAMA Binjai. Exponential Smoothing is one type of moving average forecasting technique that weighs past data in an exponential way so that the latest data has a larger weight or scale in the moving average. A group of methods that show weighting decreases exponentially with respect to older observational values. Therefore, this method is called the smoothing procedure.

3.4. Analisis Metode Forecasting Single Exponential Smoothing

This Single Exponential Smoothing method will be applied to the calculation in determining the number of new students for the next year. Here's the formula for the Single Exponential Smoothing method:

3.5. Single Exponential Smoothing

In doing forecasting with single exponential smoothing method, the magnitude of alpha (③) applied is 0.1, 0.5, and 0.9. With the aim to predict the ③ that produces the smallest forecast error. By determining the ③ (alpha) of 0.1, note the forecast is as follows :

2018: not yet decided
Year 2019: determined the number of prospective students
New Year 2018 amounted to 241
year 2020 : $S_{t+1} = aX_t + (1- a) S_t$

= (0.1 x 286) + (1 – 0.1) 241

= 28,6 + 216,9
= 245,5

year 2021 : S_{t+1} = aX_t + (1- a) S_t
= (0.1 x 317) + (1 – 0.1) 286
= 31,7 + 25,74
= 57,44

year 2022 : S_{t+1} = aX_t + (1- a) S_t

= (0.1 x 302) + (1 - 0.1) 317
= 302 + 285,3
= 315,5

year 2023 S_{t+1} = aX_t + (1- a) S_t
= (0,1 x 305) + (1- 0,1) 302
= 305 +271,8
= 302,3

Calculating errors / errors by using
mean absolute error (MAE).
year 2018: yet to be determined
year 2019 : MAE = MAE = $\frac{\sum|X_t - F|}{n}$
= 286 - 241 / 4
= 11,25
year 2020 : MAE = MAE = $\frac{\sum|X_t - F|}{n}$
= 317 – 245,5 / 4
= 17,875

year 2021 : MAE = $\frac{\sum|X_t - F|}{n}$
= 302 – 57,44 / 4
= 61,14
year 2022 : MAE = $\frac{\sum|X_t - F|}{n}$
= 305 – 315,5 / 4
= -2,625

If it is 0.5, the forecast is as follows.
2018: not yet decided
2019: determining the number of candidates
new students in 2018 amounted to 241.
year 2020 : S_{t+1} = aX_t + (1- a) S_t
= (0,5 x 286) + (1 – 0,5) 241
= 143 + 120,5
= 263
Year 2021 : S_{t+1} = aX_t + (1- a) S_t
= (0,5 x 317) + (1 - 0,5) 286
= 158,5 + 143
= 301, 5
Year 2022 : S_{t+1} = aX_t + (1- a) S_t

= (0,5 x 302) + (1 – 0,5) 317
= 151 + 158,5
= 309
Year 2023 : S_{t+1} = aX_t + (1- a) S_t

= (0,5 x 305) + (1 – 0,5) 302
= 152,5 + 151
= 303,5

Make mistakes by using
mean absolute error (MAE)
Year 2018 : can not be determined yet
Year 2019 : MAE = $\frac{\sum|X_t - F|}{n}$

= 286 – 241 / 4
= 11,25

Year 2020 : MAE = $\frac{\sum|X_t - F|}{n}$

= 317 – 263 / 4
= 13,5

Year 2021 : MAE = $\frac{\sum|X_t - F|}{n}$

= 302 – 301,5 / 4
= 0,125

Year 2022 :

= 305 – 309,5 / 4
= -1,125 MAE = $\frac{\sum|X_t - F|}{n}$

If the calculation of the forecast is determined by 0.9 is as follows.
Year 2018: yet to be determined
2019: determining the number of candidates new students in 2018 amounted to 241.
Year 2020 : S_{t+1} = aX_t + (1- a) S_t

= (0,9 x 286) + (1 – 0,9) 241
= 257,4 + 24,1
= 281,5

Year 2021 S_{t+1} = aX_t + (1- a) S_t
= (0,9 x 317) + (1 – 0,9) 286
= 285,3 + 28,6
= 313,9

Year 2022 : S_{t+1} = aX_t + (1- a) S_t

= (0,9 x 302) + (1 – 0,9) 317
= 271,8 + 31,7
= 303,5

Year 2023 : S_{t+1} = aX_t + (1- a) S_t

= (0,9 x 309) + (1 – 0,9) 309
= 278,1 + 30,9
= 309

Calculating errors / errors by using mean absolute error (MAE)
Year 2018: yet to be determined

Year 2019 : MAE = $\frac{\sum|X_t - F|}{n}$

= 286 – 241 / 4
= 11,25

Year 2020 : MAE = $\frac{\sum|X_t - F|}{n}$

= 317 – 281,5 /4
= 7,1

Year 2021 : MAE = $\frac{\sum|X_t - F|}{n}$

= 302 – 313,9 / 4
= -2,975

Year 2022 : MAE = $\frac{\sum|X_t - F|}{n}$

= 305 – 303,5 / 4
= 0,375

The purpose of the above calculation is to find out (a) alpha which produces the smallest forecast error. By taking data on the number of new students in the previous period, forecasting by determining the value of weight (a) alpha. The value of weight (a) alpha depends on the number of new students, where the nature of this forecasting determination of the value that is closest to the actual conditions. The forecasting results above are the closest to the overall number of new students alpha 0.9 is 1,207.9 and forecast error is 15.75.

4. Conclusion

The purpose of the above calculation is to find out (a) alpha which produces the smallest forecast error. By taking data on the number of new students in the previous period, forecasting by determining the value of weight (a) alpha. The value of weight (a) alpha depends on the number of new students, where the nature of this forecasting determination of the value that is closest to the actual conditions. The forecasting results above are the closest to the overall number of new students alpha 0.9 is 1,207.9 and forecast error is 15.75.

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